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(54) Title: COMPOSITE FABRICS COMPRISING CONTINUOUS FILAMENTS LOCKED IN PLACE BY INTER- MINGLED MELT BLOWN FIBERS AND METHODS AND APPARATUS FOR MAKING		
(57) Abstract <p>A low cost, high web integrity fabric (44) that can be economically produced and tailored to provide a variety of different combinations of characteristics and properties for different end uses. It is a fabric wherein the strength in any direction can be predetermined and also wherein the elasticity in any direction can be varied in a predetermined fashion. It is also a fabric that combines continuous filaments (16), ranging from elastomeric to non-elastic but elongatable to at least a minimum extent, for strength and elasticity with the predetermined indepth intermingling of fibrous melt blown webs (22, 28) for interlocking of the said continuous filaments in the formation of the integrated, fibrous and continuous filament matrix.</p> <div data-bbox="1117 1276 1507 1948" data-label="Image"> </div>		

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COMPOSITE FABRICS COMPRISING CONTINUOUS FILAMENTS
LOCKED IN PLACE BY INTERMINGLED MELT BLOWN FIBERS
AND METHODS AND APPARATUS FOR MAKING

Background of the Invention

5 This invention pertains to low cost disposable composite fabrics, including elasticized fabrics, and a method and apparatus for making the same. More particularly, the present invention is concerned with
10 at least one non-random laid continuous filament web joined with one or more melt blown webs, wherein the melt blown fibers of a first melt blown web intermin-
15 gle with filaments of the non-random laid continuous filament web or intermingle with the fibers of a simultaneously deposited second web on the opposite side of the non-random laid web.

 There has been a desire and great need in the disposable garment and diaper field for low cost disposable composite fabrics, including elasticized fabrics. The fabric should be:

- 20 1. elastic to provide a tight yet comfortable fit;
2. water repellent to retain fluids, yet be breathable to allow exchanges of vapors through the material;
- 25 3. have high bulk yet be soft, drapable

- 2 -

with good hand and softness; and

4. opaque for use as disposable garments.

In addition there is a great need for a high strength fabric, low in cost and permitting fast stride-through of body fluids, which fabric can be formed by utilization of low cost machinery and an economical process.

The formation of the various prefabricated fibrous webs referred to herein is performed with the use of melt blowing techniques for forming fibers. These melt blowing techniques for forming fibers from thermoplastic resins, elastomeric fibers and non-elastic but elongatable fibers, can be prepared by known techniques as described in an article by Van A. Wentz entitled "Superfine Thermoplastic Fibers" appearing in Industrial and Engineering Chemistry, Vol. 48, No. 8, pp. 1342 to 1346.

Another publication dealing with melt blowing is Naval Research Laboratory Report 111437 dated April 15, 1954. According to this publication, the melt blowing process comprises heating a fiber forming resin to a molten state and extruding it through a plurality of fine orifices into a high velocity heated gas stream which attenuates the extrudate to form the melt blown fibers. This process is further described in U.S. Patent No. 3,849,241 to Butin et al., the disclosure of which is incorporated herein in its entirety by reference and relied upon.

This invention relates to provisions for solutions some of these needs.

Summary of the Invention

The known composite non-woven fibrous fabrics formed to date do not have stabilized, non-random, laid, continuous filaments intermingled with melt blown fibers in between and around the continuous fil-

aments, to join the melt blown fibers and the continuous filaments thereby locking the continuous filaments in place and forming an integrated fibrously joined, layered fabric, in which the said layers cannot be separated without their destruction.

This invention, then, relates to low cost, high web integrity fabrics that can be economically produced and tailored to provide a variety of different combinations of characteristics and properties for different end uses. It is a fabric wherein the strength in any direction can be predetermined and also wherein the elasticity in any direction can be varied in a predetermined fashion. It is also a fabric that combines continuous filaments, ranging from elastomeric to non-elastic but elongatable to at least a minimum extent, for strength and elasticity with the predetermined indepth intermingling of fibrous melt blown webs for interlocking of the said continuous filaments in the formation of the integrated, fibrous and continuous filament matrix.

Other objects and advantages of the invention will become apparent hereinafter.

Description of the Drawing

Fig. 1 is a perspective view of an apparatus constructed according to one embodiment of the invention, showing the forming section of a high speed, low cost elasticized fabric forming machine.

Fig. 2 is a perspective view of an embodiment of the invention slightly modified from that shown in Fig. 1, showing two opposed melt blown dies which are simultaneously depositing two opposed gas-fiber streams onto a stabilized, cross-laid, continuous filament web.

Fig. 3 is a perspective view of a further modification of the embodiment shown in Fig. 2, show-

ing an elasticized fabric forming machine.

Fig. 4 is a perspective view of a further modification of the embodiment shown in Fig. 3, showing a machine for forming breathable absorbent fabrics.

Fig. 5 is a perspective view of an alternative embodiment of the invention, showing a machine for forming high bulk fibrous fabric with scuff resistant surfaces.

Fig. 6 is a perspective view of another alternative embodiment of the invention, showing a machine for making highly entangled fibers and continuous filament high bulk fabrics.

Fig. 7 is an end view of an apparatus which is a slight modification of that shown in Fig. 6, showing optional parent rolls.

Description of the Preferred Embodiments

In accordance with the present invention, then, low cost disposable fabrics, including elasticized fabrics of superior formation, strength and toughness are produced by the use of a stabilized continuous filamentary web, the manufacture of which is fully described in Sabee, U.S. Patent No. 4,910,064, the disclosure of which is incorporated herein by reference and relied upon. It is this use of stabilized continuous filaments in combination with melt blown gas-fiber streams which, upon simultaneous deposition onto both sides of the stabilized continuous filaments, intermingle with each other and lock the continuous filaments in place by the joining of the two intermingled melt blown webs. These joinings or junctions range from mechanical entanglement to fusion bonding of the fibers. This intermingled joining of the melt blown fibers whether it be mechanical intermingling only or fusion bonding ranging from stick

bonds to full fusion bonds, is not a bond of the continuous filaments at their intersections. Hence the continuous filament intersections remain free to slip and slide over one another. This ability of the continuous filaments to slip and slide over one another during use drastically reduces the stiffness of the fabric and enhances the drape and hand. The improved drape and hand provided by this fabric, combined with the intermingling of the two opposing melt blown fibrous web surface fibers, form an integrated matrix of fibrous filaments and predetermined non-random laydown orientation of continuous filaments having a high cohesion and web integrity in a single step.

The intermingling of melt blown fibers with a predetermined laydown orientation of drawn, molecularly oriented continuous filaments coupled with the fusion bonding of the melt blown fibers insures the high degree of uniformity and strength in the formed fabric. This uniformity in fabric formation is especially advantageous in the formation of extremely light weight fabric, in which fiber and continuous filament forming materials may vary from elastomeric to non-elastic polymers and in which lower cost fiber forming materials must be used to meet competitive prices at the marketplace.

The terms "melt blown fibers", "melt blown fibers and/or filaments", and "melt blown fibers or filaments" are herein used interchangeably and refer to fiber lengths varying from short fibers to substantially continuous length filaments. Melt blown fibers may be adhesive fibers from materials including pressure sensitive, elastomeric, pressure sensitive elastomeric, hot melt or any fiberizable thermoplastic polymer, co-polymer or blend of polymers.

The continuous filaments are prepared by

5 simultaneously spinning a multiple number of continuous filaments of a synthetic polymer such as a polypropylene or an elastomeric polymer through a multiple number of spinning nozzles or spinnerets, preferably extending in one or more rows. Upon exiting the spinnerets the filaments enter a controlled temperature chamber and are drawn away from the spinneret orifice at a greater rate than the rate of extrusion. Thus is effected a substantial draw down of the filaments in the molten state prior to solidification thereof. The solidified filaments having a low degree of molecular orientation are then subjected to a mechanical draw down with draw rolls under closely controlled temperature and velocity conditions thereby imparting a much higher degree of molecular orientation to the continuous filaments.

10 The melt blowing of adhesive fibers is performed by the same technique as in the previously discussed article by Van A. Went, and have diameters ranging from less than 0.5 microns to more than about 250 microns. These adhesive fibers are made by extruding a molten thermoplastic adhesive material through a plurality of fine die capillaries as a molten extrudate of filaments into a high velocity gas stream which attenuates the filaments of molten adhesive material to reduce their diameter to the above stated range in the formation of microfibers or filaments. Any fiberizable hot melt adhesive material is suitable in the formation of adhesive fibers to be used in the intermingling and the joining of stratified fibrous fabrics. Elastomeric adhesives, pressure sensitive adhesives, pressure sensitive hot melts, viscoelastic hot melts, self-adhering elastic materials and conventional hot melt adhesives are some of the adhesives suitable for forming adhesive fibers.

It is to be understood, however, that the present invention is not to be limited to these specific adhesives.

5 As has been previously stated, the melt
blown adhesive fibers do not stiffen the fibrous
stratified fabrics as do the roller applied or coated
adhesives. These latter adhesives often fill crevices
and interstices between the fibers of the fibrous lay-
10 er or web and, after solidification, bind groups of
fibers together, which stiffens the fibrous layer and
has a deleterious effect on the hand and drape. The
melt blown adhesive fibers on the other hand act as do
the fibers of the layered fibrous web and not as
15 sprays such as paint sprays, wherein small droplets of
paint are emitted from the gun. The melt blown fi-
bers, being flexible and of small diameter, are turbu-
lently entangled with the fibrous web fibers and form
bonds at their intersections with these fibers. These
intersectional adhesive bonds behave similarly to fu-
20 sion bonds with no noticeable stiffness of the compos-
ite fabric. They also provide the additional feature
that the elastomeric adhesive fibers stretch or elon-
gate under stress.

25 Other materials for use in forming indepth,
joined, stratified webs are polyolefins such as poly-
propylene, polyethylene, polybutane, polymethylden-
tene, ethylenepropylene co-polymers; polyamides such
as polyhexamethylene adipamide, poly-(oc-caproamide),
polyhexamethylene sebacamide, polyvinyls such as poly-
30 styrene, thermoplastic elastomers such as polyure-
thanes, other thermoplastic polymers such as polytri-
fluorochloroethylene and mixtures thereof; as well as
mixtures of these thermoplastic polymers and co-poly-
mers; ethylene vinyl acetate polymers, synthetic poly-
35 mers comprising 40% or more of polyurethane; polyeth-

eresters; polyetherurethane; polyamide elastomeric materials; and polyester elastomeric materials S-EB-S Kraton "G" Block co-polymers and Kraton GX 1657 Block co-polymers as furnished by Shell Chemical Company; 5 polyester elastomeric materials under the trade name "Hytrel" from the Dupont Company; polyurethane elastomeric materials under the trade name "Estane" from B. F. Goodrich and Company and polyamide elastomeric material under the trade name "Pebax" from Rilsam Compa- 10 ny, including co-polymers, blends or various formulations thereof with other materials. Also included are viscoelastic hot melt pressure sensitive adhesives such as "Fullastic" supplied by H.B. Fuller and Compa- 15 ny and other hot melt adhesives including pressure sensitive adhesives. Any of the fiber forming thermoplastic polymers including fiber forming hot melt adhesives, pressure sensitive adhesives, and viscoelastic hot melt pressure sensitive adhesives can be used for stabilizing the web or bonding the stabilized web 20 to one or more cellulose webs, wood pulp webs, melt blown fibrous mats, or for laminating and bonding two or more stabilized webs to form laminates. The instant invention is not limited by the above polymers, for any thermoplastic polymer, co-polymer or mixture thereof capable of being melt blown into fibers or 25 filaments is suitable. Any of the thermoplastic elastomers which are capable of being melt blown or melt spun are suitable for the manufacture of stretchable fabrics.

30 The continuous filaments used herein to form a curtain of continuous filaments can be of many materials, natural or manmade, ranging from textile threads or yarns composed of cotton, rayon, hemp, etc. to thermoplastic polymers. This invention is not lim- 35 ited to the use of any particular fiber, but can take

5 advantage of many properties of different fibers. A curtain of continuous filaments or threads using multifilament threads of rayon or nylon is readily stabilized by depositing a layer of molten melt blown fibers or filaments on this continuous filamentary web. Upon cooling, the molten melt blown filaments become tacky and self-bond to the continuous rayon or nylon threads.

10 In the preferred embodiments, thermoplastic melt spun continuous filaments are used which involve continuously extruding a thermoplastic polymer through a spinneret thereby forming a curtain of individual filaments. Among the many thermoplastic polymers
15 suitable for the continuous filaments are polyolefins such as polyethylene and polypropylene; polyamides, polyesters such as polyethylene terephthalate; thermoplastic elastomers such as polyurethanes; thermoplastic co-polymers; mixtures of thermoplastic polymers; co-polymers and mixtures of co-polymers; as well as
20 the previously listed materials used herein for the melt blown fibers and filaments. However, the present invention is not limited to these materials, for any melt spinnable polymer is suitable, including all adhesive materials and spun bonded materials listed
25 herein, and melt blown materials. Other spinnable thermoplastic elastomers which are suitable for stretchable fabrics include but are not limited to polyester based polyurethane, and polyester type polyurethane polymeric fiber forming elastomers such
30 as Texin 480A supplied by Mobay Chemical Company.

35 It will be understood that this invention is not to be limited to the aforementioned materials. On the contrary, it is intended that all fiberizable thermoplastic polymers, co-polymers and blends thereof, in addition to wood pulp or cellulose fibers and

including staple fibers and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims are to be included.

5 Referring now to Fig. 1, there is shown the forming section of a high speed, low cost, elasticized fabric forming apparatus 10 which is also capable of producing non-elastic, high strength, high bulk, opaque light weight fabrics for use in disposable garments. Apparatus 10 is also capable of forming combinations of both elastic and non-elastic properties
10 in the same fabric for special uses.

Apparatus 10 includes three extruders: extruder 12 is provided with a melt spun die head 14 for forming molten elastomeric continuous filaments or molten non-elastic but elongatable filaments, both
15 referenced by numeral 16; extruder 18 is provided with melt blown die head 20 for melt blowing fibers and/or filaments 22; and extruder 24 is provided with melt blown die head 26 also for melt blowing fibers and/or
20 filaments 28.

If an elasticized web is to be formed, an elastomeric material of an elastomeric thermoplastic polymer such as Kraton G2730X which is also a styrenic block co-polymer comprising styrene end blocks with rubber mid-blocks, (SEBS Styrene-Butylene-Styrene), or
25 Kraton D2120X which is also a styrenic block co-polymer comprising styrene end blocks with rubber mid-blocks, (SBS Styrene-Butadiene-Styrene), is fed into the hopper of extruder 12 and formed into one or more rows of molten continuous elastomeric filaments 16 by
30 the die head 14 which contains one or more rows of spinnerets or capillary nozzles. The molten elastomeric filaments 16 are cooled, solidified and stretched as they are drawn from the nozzles by counter-rotating temperature controlled pull rolls 30.
35

5 The cooled, solidified, stretched filaments 32 are subsequently pulled, while under tension, into the nip of a pair of temperature controlled deposition rolls 34 simultaneously with the deposition of two opposing melt blown gas-fiber streams or sprays 22 and 28 which are simultaneously and turbulently intermingled with each other and between the tensioned continuous elastomeric filaments 34. Thus is formed a fabric 36 comprising an integrated fibrous matrix of heat softened fibers and physically entrapped and mechanically entangled, tensioned, continuous elastomeric filaments.

10 This tensioned, coalesced fabric 36 may be further stretched or elongated, if desired, by stretching the fabric between the feed rolls 38 and the higher surface velocity of the draw rolls 40. Alternatively, the fabric 36 may be stretched or elongated by the use of the incremental stretch rolls 42, which then replace draw rolls 40. Draw rolls 40 may be withdrawn to the positions shown in phantom at 40a, for example. The incremental stretch rolls 42 then incrementally stretch the fabric 36 as further described in U.S. Patent No. 4,223,063 and U.S. Patent No. 4,153,664. The elongated fabric 44 containing stretched elastomeric filaments 16 is subsequently relaxed upon exiting from the pull rolls 46, and upon contracting, forms gathers in the melt blown depositions 22 and 28 of the relaxed fabric 48 which is subsequently wound into rolls.

25 If further bonding or additional compacting is desired, the elongated fabric 44 may be passed through a pair of temperature controlled embossing rolls 50, in place of or in addition to pull rolls 46. Generally, one of the rolls 50 is smooth while the other roll contains a plurality of raised projections 50a that form autogenous or fusion bonds at the raised

30

35

point or projection locations. This process is further described in Sabee '064 and in Brock et al., U.S. Patent No. 4,041,203, and is hereafter referred to as "pin-bonding".

5 Enhanced fusion bonding at the intersection of fibers 22 and 28 with each other and fusion bonding of fibers 22 and 28 with molten filaments 16, are obtained by disengaging pull rolls 30, that is, by repositioning them to the positions shown in phantom in
10 Fig. 1. Also, the distance between the extrusion dies 20 and 26 and the molten continuous filaments 34 may be varied. In this manner, heat softened melt blown fibers 22 and 28 are able to intermingle with the heat softened continuous elastomeric filaments 16 while all
15 the fibers 22 and 28 and the continuous filaments 16 are in the heat softened plastic state.

 If a non-elasticized fabric is to be formed, it is only necessary to replace the elastomeric material in the extruder 12 with any thermoplastic polymer which will form continuous filaments upon being exited
20 from the spinneret 14 orifices upon the application of heat and pressure. A thermoplastic melt spinnable polymer is fed into the hopper of extruder 12 and formed into one or more rows of molten continuous filaments 16 and processed as previously described in the
25 processing of elastomeric fabrics. However, upon stretching between the feed rolls 38 and the draw rolls 40, followed by a relaxing step, the fabric does not contract as does the elasticized fabric, but remains substantially at its elongated length. The
30 amount of recovery after stretching varies with the polymers used and their formulations. The resultant filaments are molecularly oriented in the longitudinal direction, resulting in a smaller diameter, longer and
35 higher strength non-elastic filament as further de-

scribed in Sabee '064.

5 Fig. 2 shows a stabilized non-random fila-
mentary web 52 which is further described in Sabee
'064, receiving two opposing simultaneous depositions
of melt blown fibers 22 and 28 from two opposing die
heads 20 and 26. These fibers 22 and 28 are turbu-
lently intermingled with each other and the non-random
laid continuous filaments of web 52, while forming
fusion bonds which lock the continuous filaments in
10 place. Only a small portion of the intermingled fi-
bers need be intermingled with each other and between
and around the continuous filaments to increase tre-
mendously the tenacity of the fibrous joining, which
results in the forming of the integrated fibrously
15 joined layered fabric 54.

The simultaneous deposition of fibers, in a
heat softened nascent condition, forms fusion bonds
far superior to the fusion bonds formed by the deposi-
tion of fibers onto an already formed web wherein the
20 fibers are already solidified. The surfaces of fresh-
ly formed fibers in a heat softened condition or in a
soft nascent condition at elevated temperatures form
highly coherent fusion bonds, since the surfaces are
more compatible to surface fusion at lower tempera-
25 tures, than does a heat softened fiber which is to be
fusion bonded to a previously formed, cooled, and so-
lidified fibrous web.

Webs comprising stabilized continuous elas-
tomic filaments intersecting each other as disclosed
30 in Sabee '064, and as shown in Fig. 2 of this applica-
tion, form the basic or precursor web for forming fab-
rics of high strength or elasticity in two or more
directions. Fig. 3 shows a stretched, stabilized,
elastic, non-random-laid filamentary web 52 receiving
35 two opposing depositions of melt blown fibers 22 and

28 simultaneously as the stabilized web is passing through the nip of two temperature controlled deposition rolls 34. At the same time, deposition rolls 34 and/or additional prefabricated webs 56 and 58 are also receiving simultaneously melt blown depositions of fibers, thereby forming stretched elasticized fabric 60. This embodiment is useful in cases where it is required that the outer surfaces of fabric 60 have a high scuff or abrasion resistance. Webs 56 and/or 58 are fed from parent rolls 62 and 64 and bonded to web 52 in the nip of deposition rolls 34. Webs 56 and 58 may be any suitable prefabricated web including but not limited to dry or wet laid webs, spun bonded webs, melt blown webs, air laid webs, hydroentangled webs, film, spun laced webs, fibrillated films, needle punched webs, high loft fabrics, and stabilized, non-random laid, continuous filament webs as described in Sabee '064. The incremental stretch rolls 42 then incrementally stretch or corrugate the fabric 60, resulting in expanded or corrugated fabric 66, which may then be accumulated on a roll, for example by a two drum winder 68.

Another variation of fabric formation is shown in Fig. 4 wherein a prefabricated high loft web 70 is fed over one of the two deposition rolls 34, while melt blown fibers 28 from die head 26 are simultaneous and turbulently deposited into the nip of deposition rolls 34 in an intermingling fashion with the non-random laid continuous filament web 52, thereby forming the breathable absorbent fabric 72. Additionally, if desired, adhesive fibers from another die head (not shown) may be simultaneously deposited and turbulently intermingled with web 52 and fibers 28 for increased bonding to web 70. Fabric 72 is then stretched if web 52 is elasticized, or lightly ten-

sioned if web 52 is non-elastic, by adjusting the velocity differential between feed rolls 38 and the draw rolls 40. The web 72 may then be pin-bonded and accumulated as described above with respect to Fig. 3.

5 The composite fabric 74 of Fig. 5 is desired to have high scuff or abrasion resistant outer surfaces. To form this fabric 74, two stabilized non-random laid continuous filament webs 52 are fed over deposition rolls 34 with the simultaneous deposition of melt
10 blown fibers 28 therebetween. These fibers 28 are, upon and during deposition, turbulently intermingled with themselves and the two webs 52 to form at least some fusion bonds with the non-random laid continuous filaments of the webs during the forming of high bulk
15 web 76. Web 76 is then passed through feed rolls and draw rolls 40 for proper tensioning and bulk control to form high bulk scuff resistant fabric 74 and subsequently wound into rolls on the two drum winder 68.

20 Extremely high bulk fabrics suitable for air filtration are obtained by intermingling portions of two or more fiber streams of melt blown filaments when they are cooled sufficiently so as to have little or no fusion bonding and when the fibers are substantially
25 turbulently intermingled before their deposition onto the collecting surface. Melt blown fibers when deposited in a heat softened condition bend and easily form and nest to the deposition surface, whether it be a smooth or a rough fibrous surface and upon cooling
30 forms much denser webs than do fibers which have been cooled to solidification and thereafter turbulently intermingled with portions of two or more solidified fiber streams before their depositions onto a collecting surface. This is because the cooled, solidified
35 fibers have taken various shapes upon solidification and have become rigid and fixed in these shapes, and

upon deposition onto a collection surface do not nest together but form loose springy batts, which flatten under pressure and expand upon release of the pressure. These loose springy batts are not as dense as those made from a single die as taught in Butin et al. '241, but rather form high loft springy resilient fabrics, since the fibers were not formed into nested positions upon collection.

An example of a composite fabric of high bulk as formed according to this invention is shown in Fig. 6 and combines the melt blown streams 22, 28 and 79 of three spinneret die heads 20, 26 and 78 with the stabilized, cooled continuous filaments 16 and 80 being drawn from two melt spinning dies 14 and 82 through two cooling chambers 84 and 86 by pull roll sets 30 and 88. These streams 22, 28, 79 and filaments are combined, alternately and simultaneously, at the nip of temperature controlled deposition rolls 34. The melt blown filaments are solidified and intermingled with each other and with the continuous filaments, the outer fibrous layers being melt blown fibers 22 and 28. The newly formed composite high bulk fabric 90 may now be fed to a two drum winder 68 by feed rolls 38, or alternately pin-bonded at temperature controlled embossing rolls 50. In this embodiment the raised projections of the embossing roll 50 are preferably larger, longer and spaced further apart than those disclosed previously, to form the dimple embossed composite high bulk fabric 92.

Fig. 7 is an end view of a fabric forming machine similar to that shown in Fig. 6. Fig. 7 very clearly shows the simultaneous intermingling and deposition of melt blown fibers 22, 28 and 78 with the stabilized elastomeric continuous filaments 16 and 80 being drawn from two melt spinning dies 14 and 82,

through two cooling chambers 84 and 86 by pull roll sets 30 and 88 and combined, alternately and simultaneously, at the nip of temperature controlled deposition rolls 34. The melt blown filaments 22, 79 and 28 are intermingled with each other and with the continuous filaments 16 and 80, the outer fibrous layers being melt blown fibers 22 and 28. This embodiment provides for parent rolls 62 and 64, carrying webs 56 and 58. Webs 56 and 58 may be fed into the nip of rolls 34 to form protective covers for a resulting elastici-
cized composite high bulk fabric 94.

While the apparatus hereinbefore described is effectively adapted to fulfill the aforesaid objects, it is to be understood that the invention is not intended to be limited to the specific preferred embodiment of composite fabrics comprising continuous filaments locked in place by intermingled melt blown fibers, and methods for making, as set forth above. Rather, it is to be taken as including all reasonable equivalents within the scope of the following claims.

I claim:

1. A non-woven fabric comprising:

a substantially longitudinal array of continuous filaments of a thermoplastic polymer in a non-random laydown orientation; and

5 two or more opposing depositions of melt blown fibers;

wherein at least some of the melt blown fibers are intermingled, under turbulent conditions, with each other and with the continuous filaments to
10 form an integrated, coalesced matrix of continuous filaments and melt blown fibers.

2. A non-woven laminate comprising at least one non-random laid continuous filament curtain of a thermoplastic polymer sandwiched between at least two depositions of melt blown fibers, wherein the melt
5 blown fibers are intermingled with each other and over and between the longitudinal filaments, and onto which is joined at least one prefabricated web to form a laminate comprising a coalesced matrix of fibers, filaments and a prefabricated web.

3. A non-woven laminate as recited in claim 2 further comprising joining material deposited between said filament curtain and said depositions of melt blown fibers, said joining material comprising
5 melt blown adhesive fibers.

4. A non-woven laminate as recited in claim 2 wherein said prefabricated web is chosen from the following group: wet laid web, dry laid web, spun bonded web, melt blown web, air laid web, hydroentangled web, film, spun laced web, fibrillated film, needle punched web and high loft fabric.
5

5. A non-woven fabric comprising at least two substantially longitudinal arrays of continuous filaments of a thermoplastic polymer in non-random

5 laid down orientations separated by a deposition of melt blown fibers onto two inner facing surfaces of said non-random laid filamentary arrays, wherein said melt blown fibers are intermingled with each other and over and between the longitudinal filaments.

6. A non-woven fabric comprising:

at least two non-random laid continuous filament curtains of a thermoplastic polymer;

5 a deposition of melt blown fibers onto two inner facing surfaces of said non-random laid filamentary curtains;

a deposition of melt blown fibers onto the outside surface of each of said non-random laid filamentary curtains;

10 wherein the melt blown fibers of adjacent melt blown fiber depositions are intermingled at least with each other and said continuous filaments of said curtains between said melt blown fiber depositions to form an integrated matrix of continuous filaments and melt blown fibers.

15 7. A non-woven fabric as recited in claim 6 wherein at least some of the fibers of one melt blown fiber deposition are intermingled with at least some of the fibers of another melt blown fiber deposition.

5 8. A non-woven fabric as recited in claim 6 wherein at least some of the fibers of one melt blown fiber deposition are intermingled with the fibers of each of the other two melt blown fiber depositions.

5 9. A non-woven fabric as recited in claim 6 wherein all three depositions of melt blown fibers are deposited simultaneously.

10. A non-woven fabric according to any one of claims 1, 2, 5 and 6 wherein at least some of said

continuous filaments are elastomeric.

11. A non-woven fabric according to any one of claims 1, 2, 5 and 6 wherein at least some of said continuous filaments are non-elastic but elongatable.

12. A non-woven fabric according to any one of claims 1, 2, 5 and 6 wherein at least some of the melt blown fibers are elastomeric.

13. A non-woven fabric according to any one of claims 1, 2, 5 and 6 wherein at least some of the melt blown fibers are non-elastic but elongatable.

14. A non-woven fabric according to any one of claims 1, 2, 5 and 6 wherein at least some of the melt blown fibers are adhesive fibers.

15. A non-woven fabric according to any one of claims 1, 2 and 6 wherein at least two opposing depositions of melt blown fibers are substantially simultaneous depositions.

16. A non-woven fabric according to claims 1, 2, 5 and 6 wherein at least some of the continuous filaments lie in a predetermined transverse direction to each other.

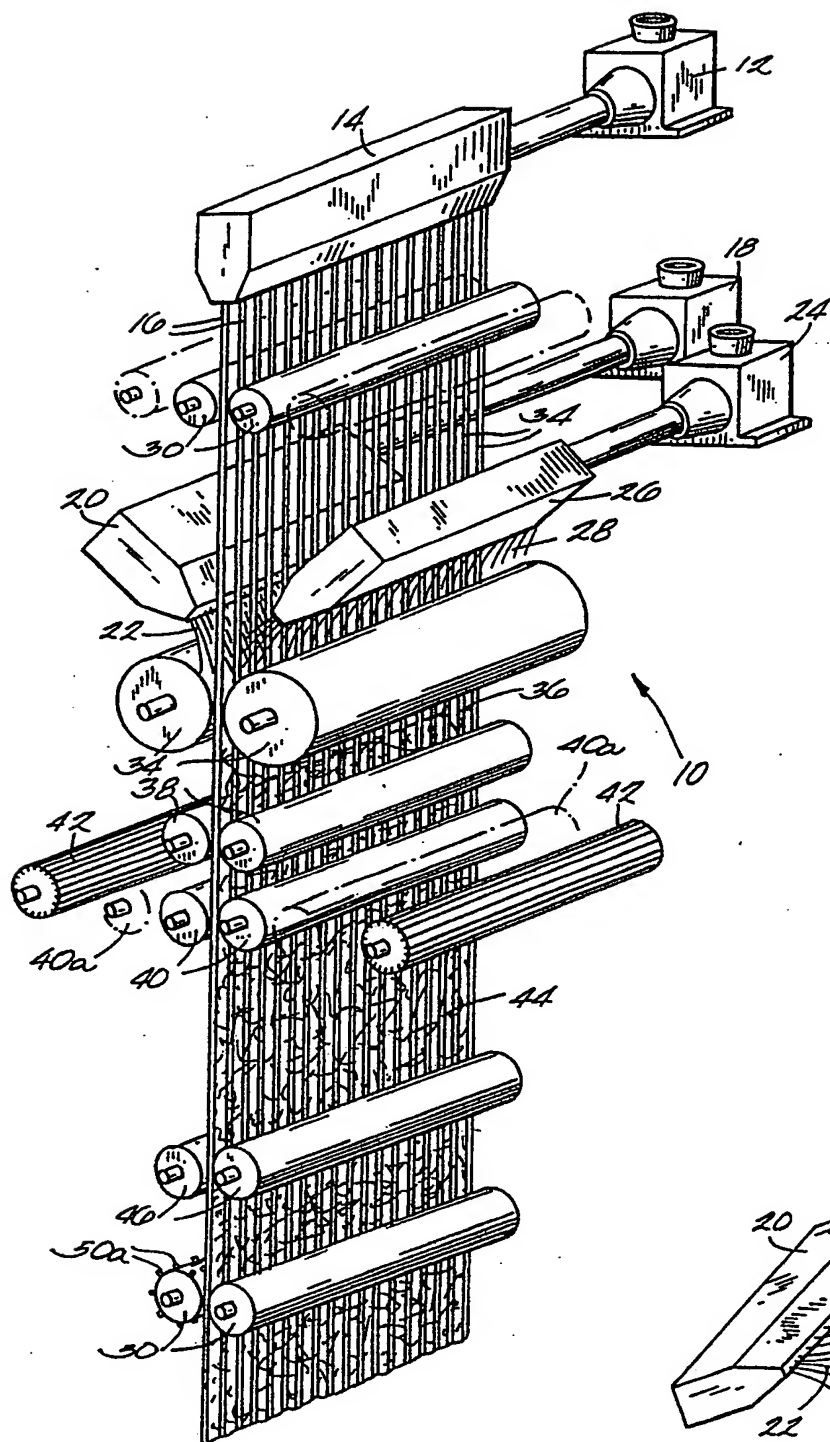


Fig. 1

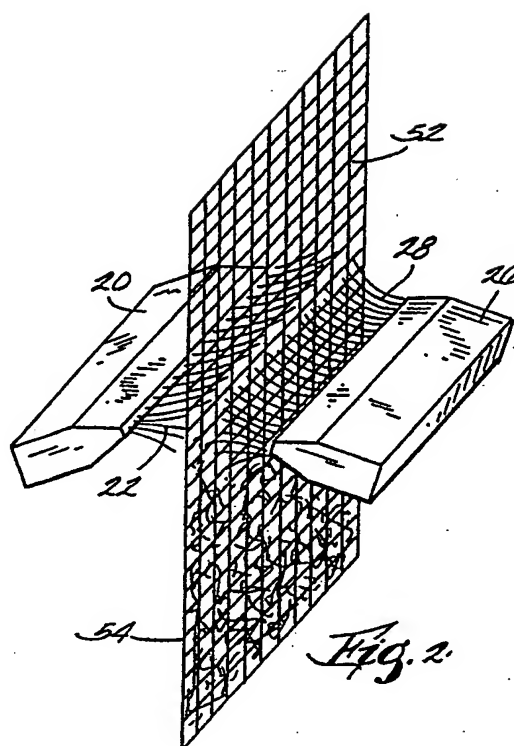
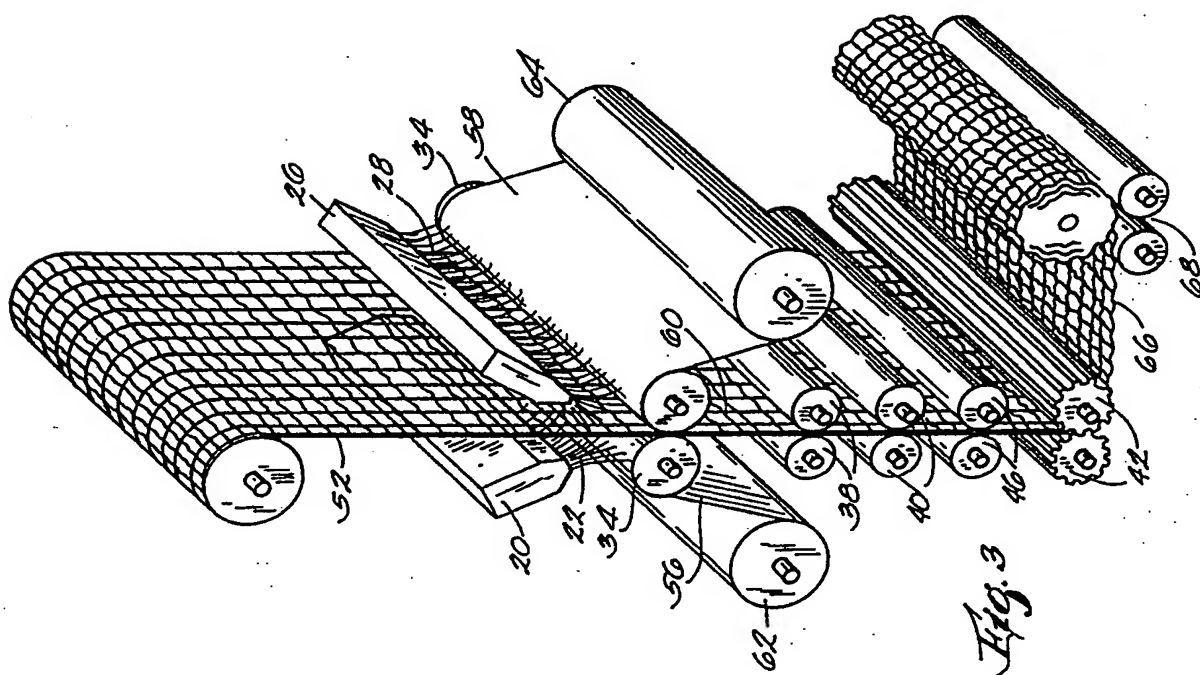
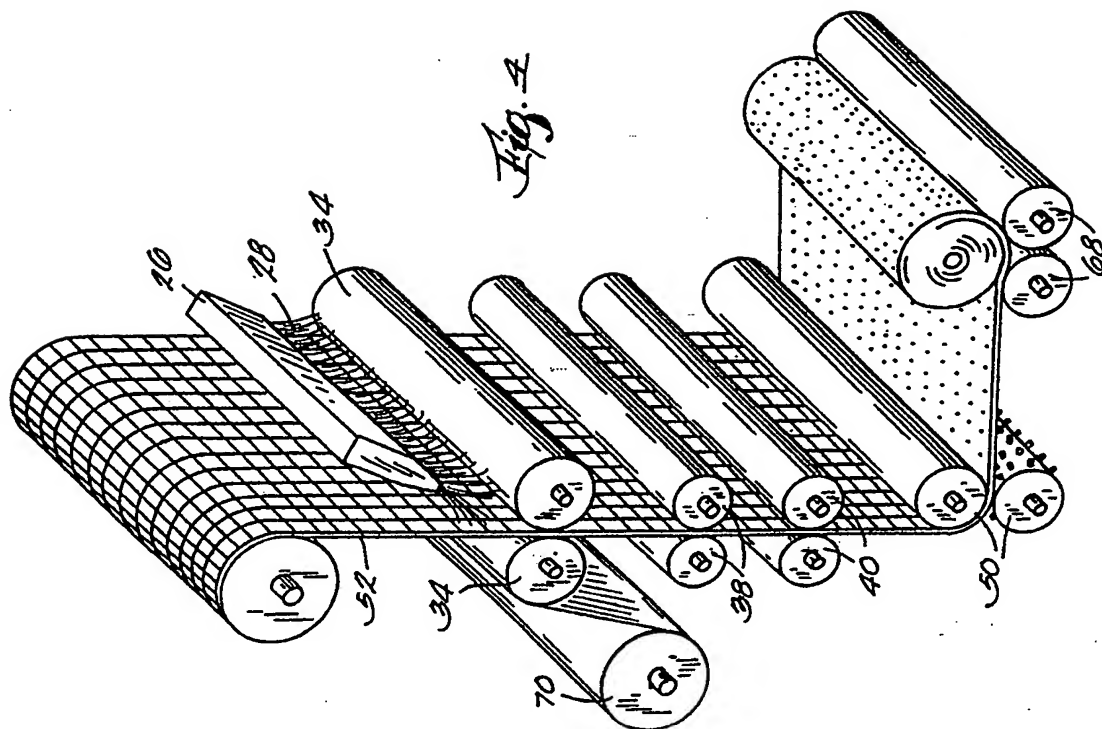
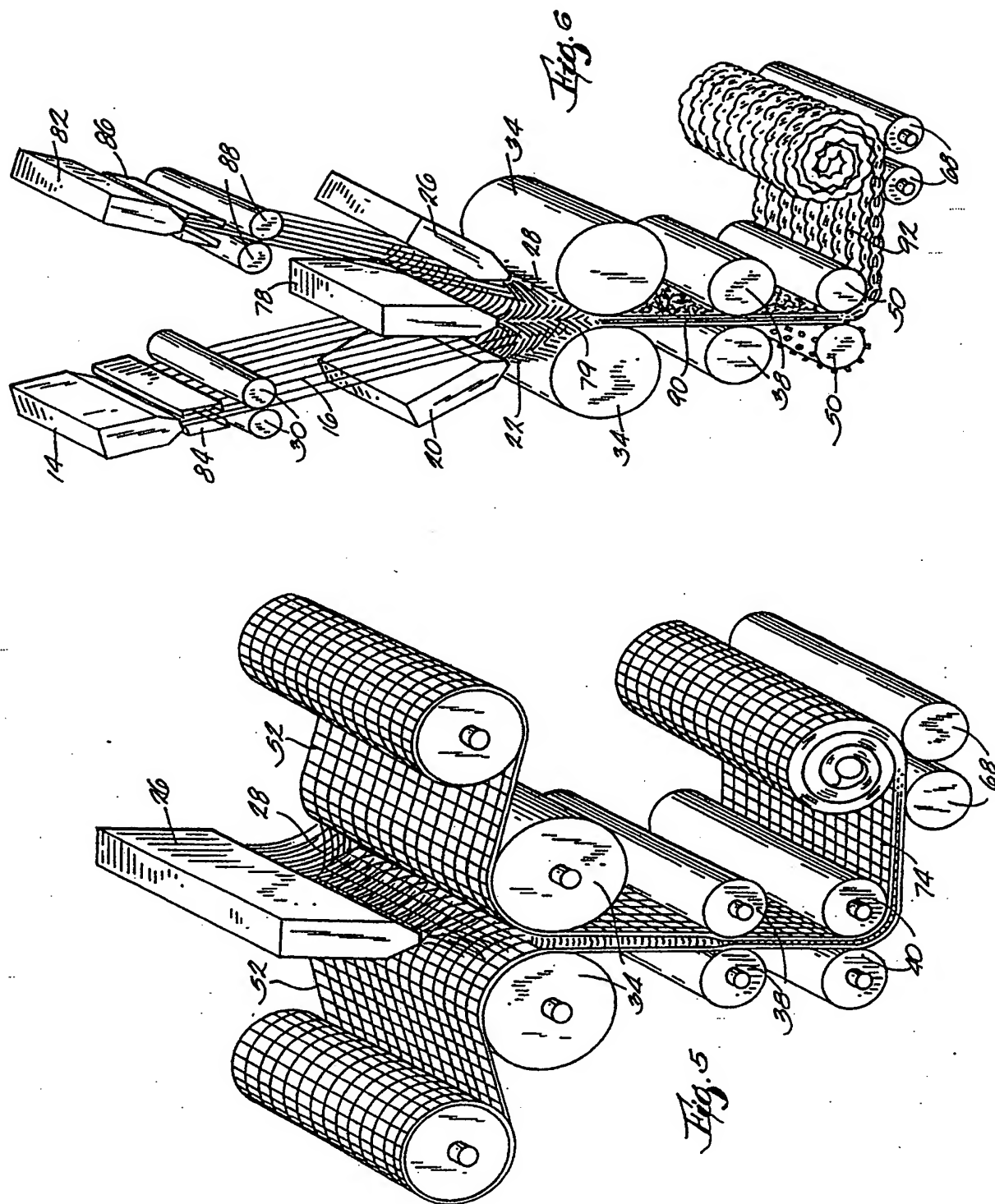
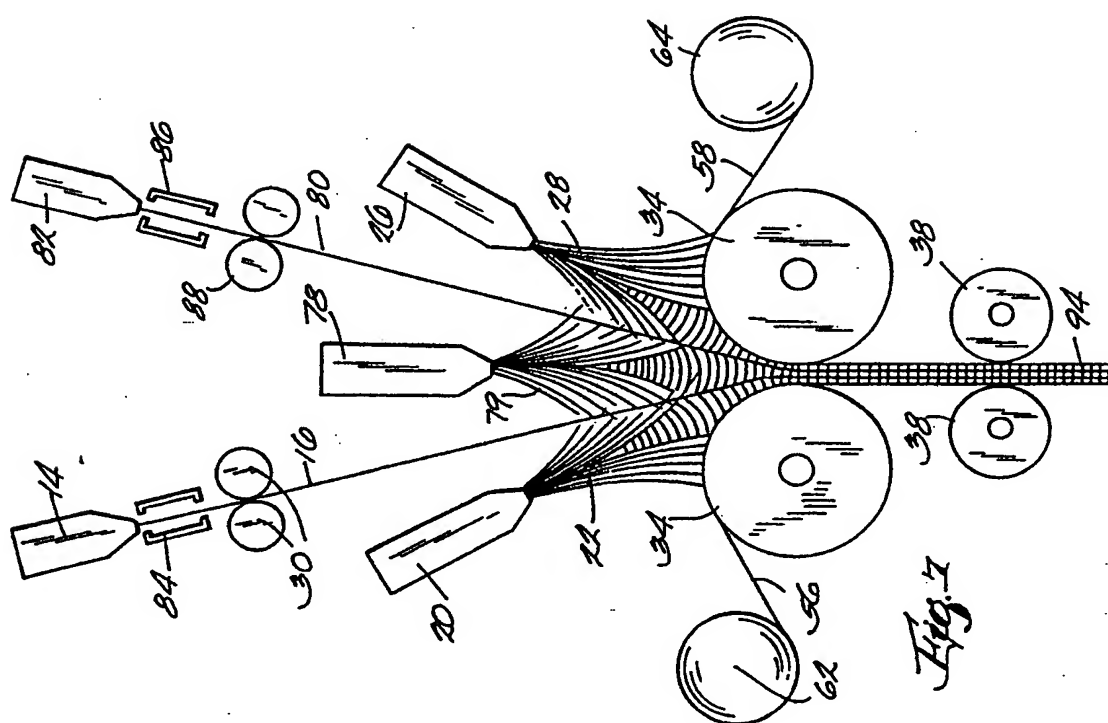


Fig. 2.

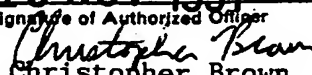






INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/06281

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC (5) : B32B 5/02		
U.S. CL. : 428/113, 198, 284, 288, 293, 294, 296, 299		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
U.S.	428/113, 198, 284, 288, 293, 294, 296, 299	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *		
III. DOCUMENTS CONSIDERED TO BE RELEVANT *		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US, A, 4,910,064 (SABEE) 20 MARCH 1990. See entire document.	1-9
Y	US, A, 4,931,355 (RADWANSKI) 05 JUNE 1990. See column 5.	1-9
Y	US, A, 4,302,495 (MARRA) 24 NOVEMBER 1981. See columns 3 and 4.	1-9
Y	US, A, 4,146,663 (IKEDA) 27 MARCH 1979. See bottom column 9 and top of column 10.	1-9
<p>* Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
23 OCTOBER 1991	13 NOV 1991	
International Searching Authority	Signature of Authorized Officer	
ISA/US	 Christopher Brown	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. ☒ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers, because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. ☐ Claim numbers, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

3. ☒ Claim numbers 10-16, because they are dependent claims not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ²

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
☐ No protest accompanied the payment of additional search fees.